

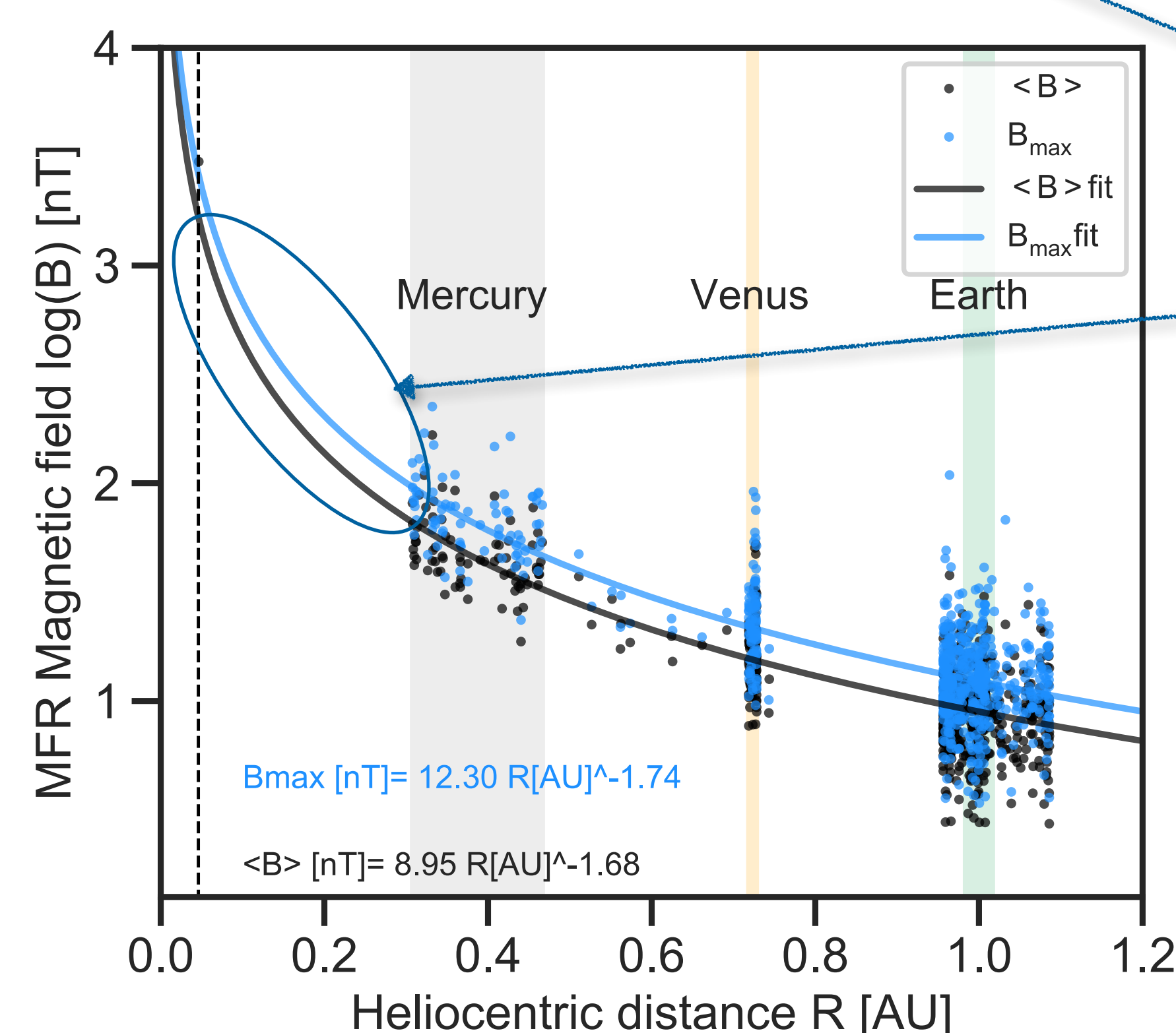
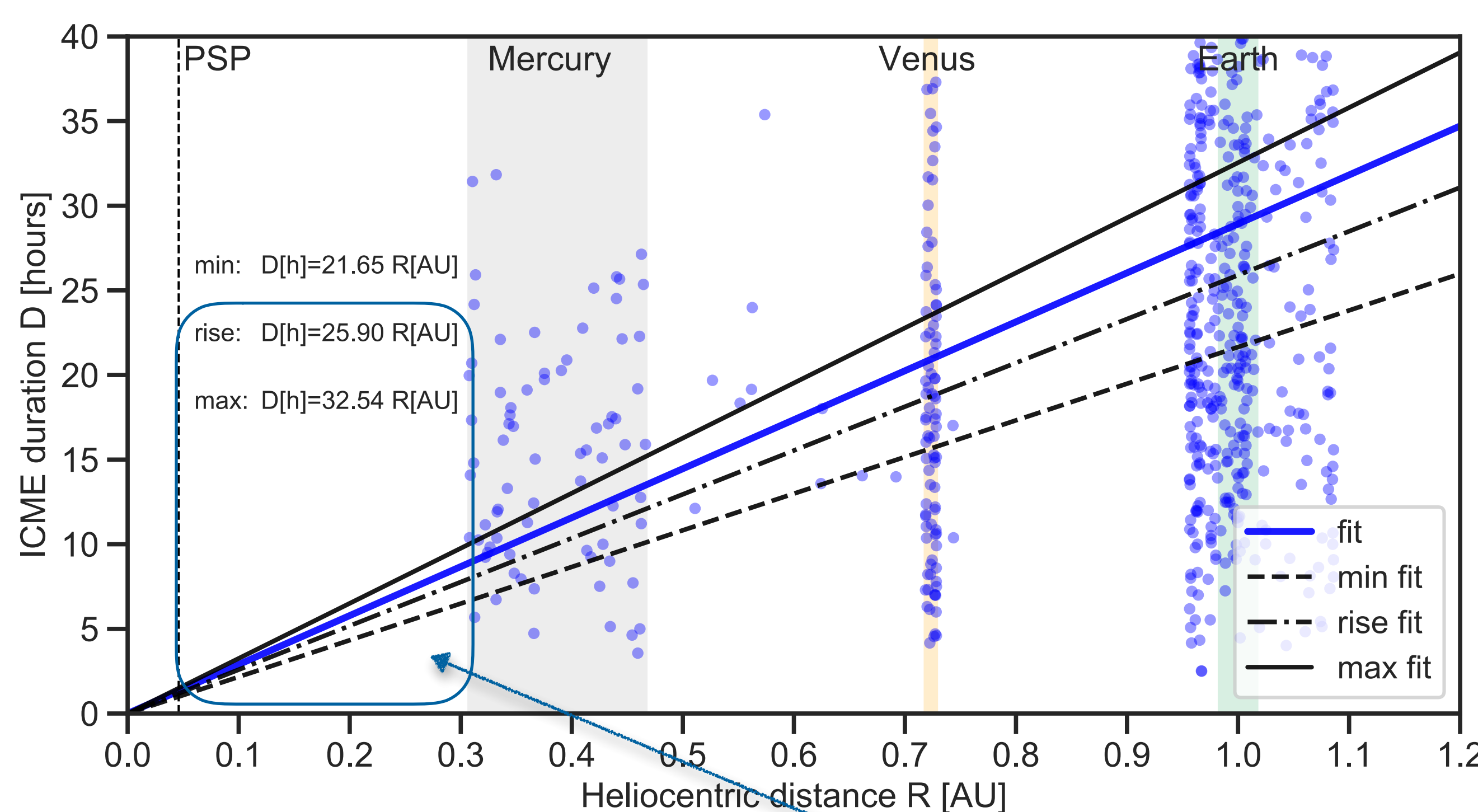
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KEY POINTS

- The *Parker Solar Probe (PSP)*, which was launched in 2018 and has already performed fly-bys of the sun at smaller distances than any man-made object before, has the possibility of **providing exciting new insights into the understanding of CME flux rope magnetic fields**, which pose an **unsolved problem in heliophysics and space weather forecasting**.
- We give an update on **expected parameters** of interplanetary coronal mass ejections (ICMEs) to be observed in the upcoming years by PSP, using the most extensive ICME catalog to date including **704 ICME observations** (to be published). A previous version is available here (668 ICMEs): https://www.helcats-fp7.eu/catalogues/wp4_icmecat.html
- We use our **semi-empirical flux rope model 3DCORE** (Möstl et al. 2018, *Space Weather*), to forward model the in situ CME flux rope field profiles to be observed by PSP during solar flybys.

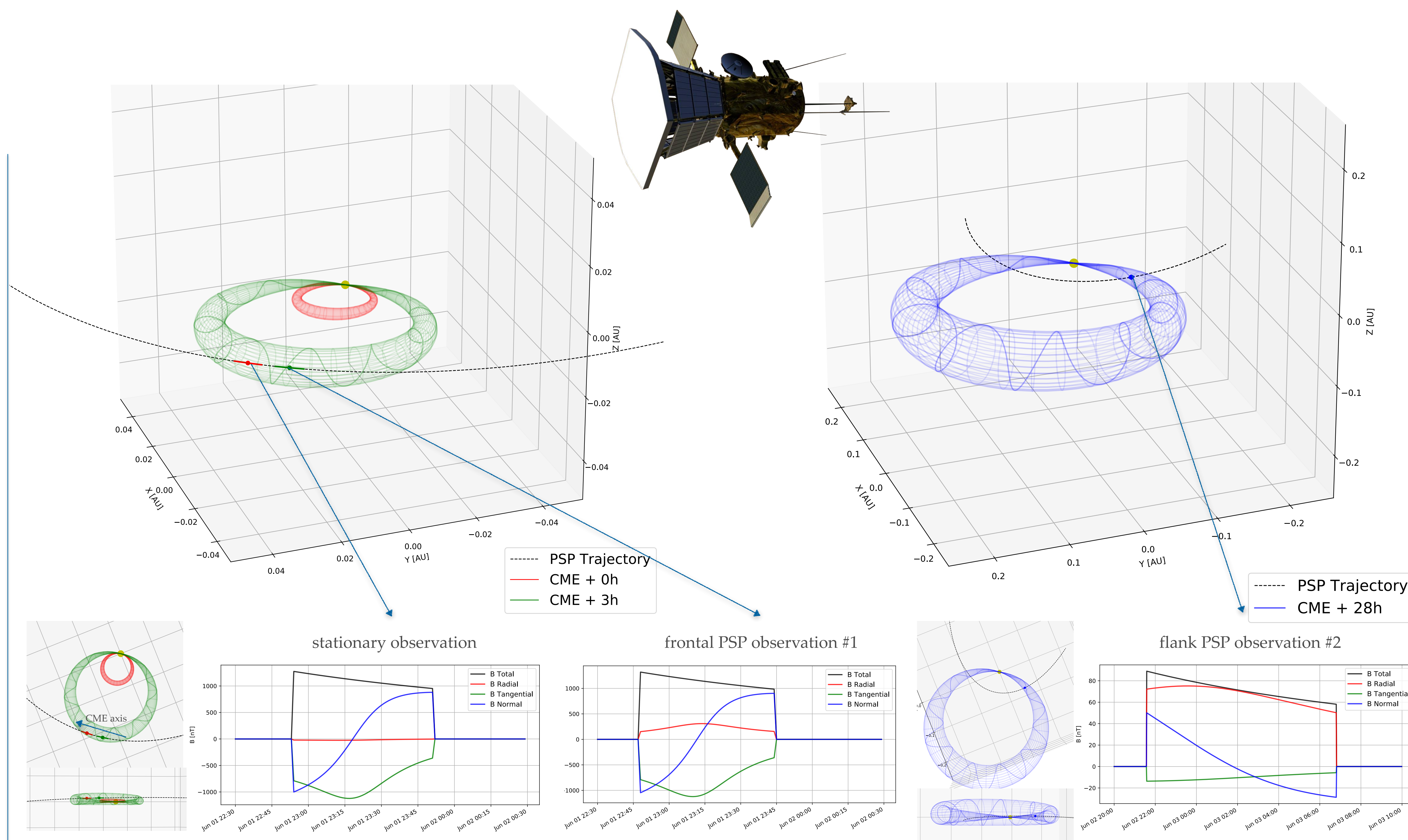


Expected ICME durations at PSP

Expected flux rope magnetic fields

ICME impact frequency:

Based on solar cycle 24, during solar minimum, PSP will observe 0.5 ICMEs / month, during solar maximum 2 ICMEs / month, or 1 event every 15 days. Thus particular during the flybys later in the mission the chances increase for a CME observation during a close solar encounter.



SIMULATED PARKER SOLAR PROBE CME ENCOUNTER

- Solar fly-by on 2022 June 1, CME launch time: 2022 June 1 20:00 UT
- CME direction: latitude in ecliptic (0°), longitude roughly points towards the fly-by perihelion. Initial CME speed 600 km/s.
- Flux rope inclination is in ecliptic (90° in our model), left-handed chirality.
- PSP passes through the model magnetic flux rope twice, which would allow to sample the CME at different positions and different times. The very different magnetic signatures observed at both encounters might be a very valuable hint to constrain the 3D CME magnetic field configuration.
- Compared to the static case, the **high relative speed** of PSP of 163 km/s during the observation leads to an additional signature in the otherwise flat B_x component.

3DCORE MODEL

- 3DCORE uses the force-free constant twist Gold-Hoyle flux rope model in an approximated 3D configuration to estimate the magnetic field components (shown in RTN coordinates).
- The geometrical shape is described using a tapered torus attached to the sun, with circular cross-section. An update of the 3DCORE prototype (Möstl et al. 2018, *Space Weather*) is in progress.

CONCLUSIONS

- We have used an update of a large database from www.helcats-fp7.eu with 704 ICME events for predicting the ICME impact frequency, their duration and magnetic field at *Parker Solar Probe*.
- We combine our **semi-empirical flux rope model 3DCORE** with the predicted PSP flight trajectory and simulate the observation of a CME during a close solar encounter that may arise during the mission. This produces highly interesting results such as a **double observation of the same CME** and a **subtle change in the magnetic field signatures** compared to a stationary spacecraft.
- The shown results therefore give an indicator of the type of measurements combined with simulations that we hope to make in the upcoming years.

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